

Anesthetic Complications and Deaths

JOHN W. PENDER, M.D., *Palo Alto*

■ *Anesthesiologists should fully inform patients of the possible complications from anesthesia. For rapport with the patient, with whom they usually have no acquaintance until a day or so before an operative procedure, the anesthesiologist should enlist the help of the internist or surgeon who already has established an atmosphere of trust.*

The extent of morbidity and minor complications from anesthesia has not been adequately recorded.

One out of every 1,000 to 2,000 anesthetized patients dies of complications primarily due to or contributed to by anesthesia.

Leading causes of death vary from study to study and from year to year.

FACTUAL INFORMATION about the true incidence and severity of complications associated with anesthesia is not adequately communicated to the average surgical patient. Too often the patient's inquiries about forthcoming anesthesia are lightly dismissed with the explanation that there will be nothing to it but a "shot in the arm." Primary responsibility for education of the patient lies with the anesthesiologist but he is hampered by his brief acquaintance with the patient, which occurs soon after admission to the hospital and at a time when the patient is distracted by many other apprehensions. Aid of the internist and surgeon, in whom the patient already has confidence, is needed for correctly informing him about complications which may occur during and after anesthesia. Only in this manner can resentment be avoided. The patient who has an anesthetic complication after having been led to believe that none ever occurs, naturally assumes that someone has been negligent.

The purpose of this paper is to review and compare some of the studies which have been made

about the character and incidence of complications associated with anesthesia in various parts of the world. Sections will be devoted to legal aspects, non-fatal complications and fatal complications.

Legal Aspects

Of the legal aspects, only the principles of *res ipsa loquitur* and *informed consent* will be discussed.

According to the principle of *res ipsa loquitur*, the court may rule that the plaintiff does not need to prove negligence on the part of the defendant but instead may call on the defendant to explain his actions. In 1944 a California court ruled that when a plaintiff receives unusual injuries while unconscious and in the course of medical treatment, all those defendants who had any control over his body or the instruments which might have caused the injuries could properly be called upon to meet the inference of negligence by giving an explanation of their conduct.¹¹ This indicates that anesthesiologists and surgeons share each others' complications.

Physicians are inclined to be paranoid about

Submitted 23 June 1967.
Reprint requests to: Palo Alto Medical Clinic, 300 Homer Avenue, Palo Alto 94301.

application of this legal procedure and believe that their rights are being infringed when they are considered guilty until they prove themselves innocent. However, a similar philosophy is being applied in other areas of human relations. At one time an injured employee had to prove negligence on the part of his employer before damages would be awarded. Now the disabled employee is considered a responsibility of society and is supported by increasingly generous workmen's compensation laws.

Modern juries rarely spend much time trying to decide responsibility for cause of automobile accidents. Emphasis is put on the amount of damages to be paid and which insurance company shall pay them. Ultimately insurance companies are social institutions representing large portions of the population. Similarly, when a patient is disabled by an anesthetic complication, the insurance company of either the physician or the hospital is the most likely source of compensation to the patient for his disability.

Consent for a medical procedure to be performed is based on the patient's information about its advantages and disadvantages. In 1960 the Supreme Court of Missouri declared that a physician owes his patient a duty to inform him, generally, of the possible serious collateral hazards.¹² It is impossible to acquaint the patient adequately with every possible complication associated with anesthesia, but there is no justification for misinforming the patient by either direct or implied statements.

Non-Fatal Complications

The total incidence of non-fatal anesthetic complications in large groups of patients has not been reported adequately. Most studies have been of one isolated complication or a related group of complications. Departmental annual reports rarely give any detail about temporary non-fatal anesthetic complications.

An exceptional study was that reported by Edmonds-Seal and Eve⁵ in which an attempt was made to elicit as many complaints as possible from patients on the first and second day after general anesthesia. In spite of early inexperience of the single interrogator, 47 percent of 513 patients admitted to at least one of the complications listed in Table 1. In general the incidence of complications noted by these observers agrees reasonably well with that reported in other studies in which only single complications were investigated. The

TABLE 1.—*Non-Fatal Complications Following General Anesthesia in 513 Cases**
(Overall Incidence, 47 Percent)

	<i>Patients</i>	<i>Percent of Total</i>
Vomiting	113	22.0
Bruises	73	14.2
Sore throat	72	14.0
Backache	25	4.9
Pain in jaw	16	3.1
Headache	14	2.7
Cough	11	2.1
Pain in heel	11	2.1
Pain in knee	9	1.7
Pain in elbow	9	1.7
Dental trauma	6	1.2
Bruise lip	5	0.9
Muscle pain	4	0.7
Pain in eye	3	0.6
Pain over nose	2	0.4
Lacerated tongue	1	0.2
Temporary deafness	1	0.2
Temporary hand numbness	1	0.2
Skin necrosis after venipuncture	1	0.2

* Adapted from Edmonds-Seal and Eve.⁵

incidence of generalized muscle pains in patients who had received a depolarizing muscle relaxant was less than that reported by some investigators, but this was explained by the fact that the patients of Edmonds-Seal and Eve had not been ambulatory at the time of questioning.

During routine post-anesthesia rounds, most anesthesiologists are too involved in trying to separate anesthetic from surgical complications to search for additional minor complaints.

Fatal Complications

During recent years many good studies have been made of the incidence and cause of fatal anesthetic complications. Before the report by Beecher and Todd¹ in 1954 on data from ten university hospitals, open discussion about fatal anesthetic complications was for the most part eschewed. The anesthetic mortality rate of 1 in 1,500 that was reported by Beecher and Todd is about the same as has been presented in subsequent reports.

In 1956 a committee appointed by the Council of Association of Anesthetists of Great Britain and Ireland studied 1,000 voluntary reports of deaths associated with anesthesia.⁶ In the committee's opinion, 589 of the 1,000 deaths were in some degree attributable to anesthesia. A condensed summary of the etiological factors associated with fatal complications is given in Table 2. The complication with the highest incidence was regurgitation and vomiting, with overdose of intravenous barbiturate a close second. Anesthesiologists

TABLE 2.—Anesthetic Deaths in England*
Causes of 589 Deaths Attributed to Anesthesia

	Deaths	Percent of Total
Regurgitation—Vomiting	110	18.6
Overdose I. V. barbiturate	107	18.1
Inadequate resuscitation	49	8.3
Endotracheal intubation	41	6.9
Post-op respiratory obstruction	33	5.6
Inadequate ventilation	26	4.4
Spinal and epidural	25	4.2
Induced hypotension	17	2.9
Bronchospasm	16	2.7
Convulsion	15	2.6
Sudden death in children	14	2.4
Trichlorethylene	12	2.2
Apparatus	10	1.7
Chloroform	6	1.0

* Adapted from Edwards.⁶

learned early the dangers of administering general anesthesia to patients with full stomachs, but only in the past five or six years have surgeons stopped insisting that minor operations of short duration could be done safely with only a "shot of Pentothal."

After the committee's study was completed, reports continued to be received and 600 were reviewed by Dinnick³ in 1964. Anesthesia was considered to have been implicated in about two-thirds of the deaths. Low blood volume due to hemorrhage, shock and dehydration was by far the leading cause of death and indicated that during the time interval between the two studies the anesthesiologist had assumed responsibility for maintenance of adequate circulation as well as respiration and anesthesia. Regurgitation and vomiting had fallen to third place as a cause of death and was considered to have been a cause of death less frequently than underventilation of the lungs.

In Australia, voluntary reporting of deaths associated with anesthesia was considered unsatisfactory and, since such cases are routinely reported to a coroner, an extensive questionnaire was sent to the anesthesiologist in charge of each patient at the time of death. Participation in this study was encouraged by declaring the information in the questionnaire confidential and thereby insuring anonymity. The information was reviewed by a committee representing several medical disciplines. Of 100 deaths, 55 were considered to have been partly or entirely caused by anesthesia, which made an estimated incidence of one death for about every 2,000 anesthetics administered in the area during the time of the study (Table 3). Overdose, inadequate management of crisis, inadequate

TABLE 3.—Anesthetic Deaths in Australia*
Causes of 55 Deaths—Estimated 1 per 2,000 Anesthetics

	Patients	Percent of Total
Overdose	27	49.0
Inadequate management of crisis	24	43.6
Inadequate preanesthetic preparation	22	40.0
Wrong choice of anesthetic	22	40.0
Inadequate ventilation	18	32.7
Inadequate resuscitation	11	20.0
Inadequate patient observation	6	10.9
Hypoxic gas mixture	5	9.0
Technical mishaps	5	9.0
Inadequate relaxant reversal	2	3.6
Inhalation of vomitus	1	1.8

* Adapted from Holland.⁷

TABLE 4.—American Anesthetic Deaths
Causes of 18 Primary Anesthetic Deaths (from Schapira¹⁰)
Incidence: 1 to 1,232

Inadequate ventilation	8
Topical cocaine	4
Ventricular fibrillation	2
Wrong choice of drug	1
Overdose of cyclopropane	1
Laryngospasm	1
High spinal	1

pre-anesthetic preparation of the patient, and wrong choice of anesthetic were the leading causes of death and each was in about the same frequency as the others. Only one fatality was attributed to inhalation of vomitus. Credit for this low incidence was attributed to the publicity of the earlier mentioned English review, which may be taken as an indication of the efficacy of education and communication in the prevention of complications.

Since the 1954 report by Beecher and Todd¹ no broad-based American study on anesthetic mortality has been conducted with which to closely compare the English and Australian studies. However, localized American reports are more numerous. Schapira and coworkers¹⁰ considered anesthesia to have been the primary cause of death in 18 of 22,177 patients who received anesthetic services, an incidence of one death for about 1,232 services (Table 4). Inadequate ventilation was the most frequent cause of death. Boba and Landmesser² divided the causes of cardio-respiratory collapse due to anesthesia into errors of commission and those of omission. The errors of omission were three times those of commission, which leads to the belief that the anesthesiologist knows how to maintain the safety of his patient but frequently reduces the margin of safety through yielding to pressure from other members of the operating team. The Baltimore Anesthesia Study Commis-

sion⁹ reviewed 1,024 postoperative deaths and found anesthesia to be a primary or contributing cause of death in about one per 2,500 operations. Error in preoperative preparation and medication of the patient was considered the cause of 29 out of 196 anesthetic deaths, emphasizing the role of the anesthesiologist in sharing overall care of the patient with internist and surgeon.

Fires and explosions, once the most dreaded of anesthetic complications, have decreased in frequency. Although no reliable statistics are available, it has been estimated that during 1964 about 58 fires and explosions occurred during anesthesia in the United States, with a mortality rate to the patient of approximately 60 percent. Most of these accidents were attributed to static electricity due to loss of electrical conductivity in rubber that was considered to be conductive.

A report by Memery⁸ on a large number of anesthetics administered in private practice indicates that the death rate approximates that found in institutional practice. The mortality rate primarily due to or contributed to by anesthesia for surgical operations, excluding obstetrics, was 1 death per 1,082 anesthetics. Inadequate monitoring of the patient and inadequate respiratory support were considered the two most frequently committed errors. As in the previous report by Dripps and others,⁴ it was found that the incidence of death was greater following general anesthesia than

after spinal anesthesia and the great majority of deaths occurred in patients with severe systemic disturbances.

REFERENCES

1. Beecher, H. K., and Todd, D. P.: A study of the deaths associated with anesthesia and surgery, *Ann. Surg.*, 140:2, July 1954.
2. Boba, A., and Landmesser, C. M.: Total cardiopulmonary collapse. Contributing and causative errors of omission and commission for which the anesthesiologist must assume responsibility, *N. Y. J. Med.*, 61:2928, 1 Sept. 1961.
3. Dinnick, O. P.: Deaths associated with anaesthesia, *Anaesthesia*, 19:536, Oct. 1964.
4. Dripps, R. D., Lamont, A., and Eckenhoff, J. E.: Role of anesthesia in surgical mortality, *JAMA*, 178:261, 21 Oct. 1961.
5. Edmonds-Seal, J., and Eve, N. H.: Minor sequelae of anaesthesia, *Brit. J. Anaesth.*, 34:44, Jan. 1962.
6. Edwards, G., Morton, H. J. V., Pask, E. A., and Wylie, W. D.: Deaths associated with anaesthesia, *Anaesthesia*, 11:194, July 1956.
7. Holland, R.: Interim report of the special committee appointed to investigate deaths due to anaesthesia in New South Wales, *Med. J. Aus.*, 49:575, 13 Oct. 1962.
8. Memery, H. N.: Anesthesia mortality in private practice, *JAMA*, 194:127, 13 Dec. 1965.
9. Phillips, O. C., Frazier, T. M., Graff, T. D., and Kornfield, T. J.: Baltimore anesthesia study committee—review of 1,024 postoperative deaths, *JAMA*, 174:2015, 7 Dec. 1960.
10. Schapira, M., Kepes, E. R., and Hurwitt, E. S.: An analysis of deaths in the operating room and within 24 hours of surgery, *Anesth. Analg. (Cleveland)*, 39:149, Mar.-Apr. 1960.
11. Wasmuth, C. E.: Changing legal concepts, *Anesth. Analg. (Cleveland)*, 41:521, July-Aug. 1962.
12. Wasmuth, C. E.: Changing legal concepts, *Anesth. Analg. (Cleveland)*, 41:525, Sept.-Oct. 1962.

